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(54) Title: DETECTION SYSTEM
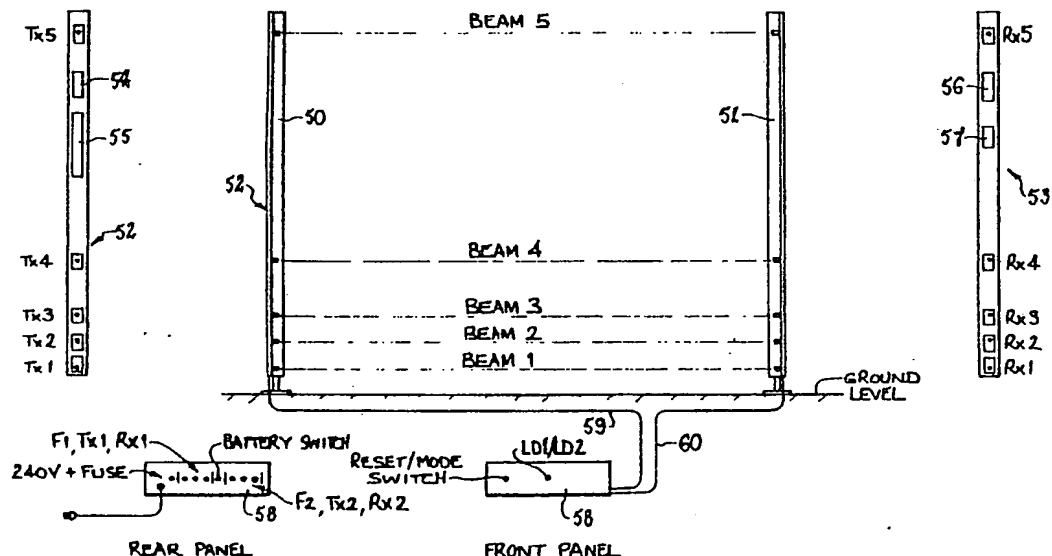
(57) Abstract

A detection system capable of distinguishing between types of intruder passing into a protected area. The detection system includes means (Tx1-5) for transmitting a plurality of electromagnetic (infrared) beams, the beams being arranged such that an intruder passing into the protected area causes a break in at least one of the beams. The detection system includes means (Rx1-5) for receiving the electromagnetic (infrared) beams and for detecting breaks in the beams. The detection system also includes processing means (57) such as a microprocessor for receiving data associated with breaks in the beams. The processing means may initiate an alarm condition whenever the data associated with the breaks in the beams matches a predetermined beam signature i.e. a predetermined number or sequence of breaks in the beams. The microprocessor may be adapted to store a library of beam signatures for the purpose of identifying certain types of intruders. A swimming pool alarm incorporating the above detection system is also disclosed.

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DETECTION SYSTEM

The present invention relates to detection systems utilizing electromagnetic radiation. More specifically, this invention relates to a detection system capable of distinguishing between types of intruder passing into a protected area.

Electromagnetic radiation has previously been used for detecting the presence of intruders, whether moving or stationary. Many existing detecting devices incorporate an alarm system which operates on the principle of intercepted electromagnetic radiation. However, a disadvantage of these systems is that they do not distinguish between types of intruder. Such alarm systems trigger regardless of the type of intruder.

The detection system of the present invention may have specific applications, for example detection of persons and other objects passing into a designated area such as a swimming pool.

Detection systems for swimming pools have been available for some time. However, those presently available are designed to detect presence of children or pets after they have fallen into the pool. These systems operate on the principle of inertia detection which relies on a child or pet moving considerably in order for detection to take place. These devices are also subject to wear and corrosion, as by their very nature, they are required to float in the pool for long periods of time.

Pool fence systems are also available, however, these systems are often obtrusive both to the eye and to the space surrounding the pool area. The present invention aims to provide a detection system which alleviates the disadvantages of the prior art.

The detection system of the present invention may include an arrangement of detection posts. The posts may be in communication with processing means. The processing means may include a microprocessor or central processing unit. The processing means may be adapted to identify

arrangement, each transmitting unit may transmit an
electromagnetic beam from the secondary post to a
corresponding receiving unit of the primary post.

The placement of each receiving unit relative to its
corresponding transmitting unit may be such that each
receiving unit receives an electromagnetic beam transmitted
by a corresponding transmitting unit. The number of beams
is not critical, but a number greater than two is preferred.

It is also possible for the secondary post to act as
10   a reflective post, to reflect transmitted beams back to the
primary post. In this situation it will be preferable that
the primary post contains both transmitting and receiving
means.

In one particular preferred embodiment, the system
may comprise transmitting units for transmitting five
separate electromagnetic beams. The transmitting units may
be arranged such that the five beams lie in a substantially
vertical arrangement. The arrangement may be such that
three transmitting units occupy lower most positions on the
20   post. These lower most units are herein referred to as
lower units. The lower units are preferably spaced at
approximately equal intervals. Each interval may be
between 5 cm to 20 cm. The arrangement may be such that
the upper most of the lower units is preferably no more
than 60 cm from the ground or surface when the post has
been installed. A fourth unit may be located approximately
mid way along the post. The fourth unit will herein be
referred to as a middle unit. The middle unit may be
located between 30 cm and 70 cm from the ground or
30   surface. A fifth unit, may be located in an upper most
position on the post. The fifth unit will herein be
referred to as an upper unit. The upper unit may be
located in the vicinity of the top of the post, and such
that it lies preferably between 100 and 250 cm from the
ground or surface.

To minimise cross talk between adjacent
electromagnetic beams, each beam may be modulated by a
38   modulating system. Each beam may be modulated such that it

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to trigger an alarm condition whenever a predetermined beam
signature is received.

The processing means may include one or more logic
units. The, or each logic unit may be user programmable or
it may comprise hard wired logic such as a diode logic
array. The processing means of the present invention may
include a control unit. The control unit may be integrated
with the processing means or it may be remote therefrom.

The receiving units in the primary post preferably
are in communication with a logic unit. This logic unit
may be contained in the primary post itself. It is
preferable that this logic unit is a programmable logic
unit and that it is programmed to recognise beam signatures
received by the receiving units. An alarm condition
preferably exists whenever an intruder intercepts a
predetermined number of electromagnetic beams.

In order to provide protection in a specific
application, namely a swimming pool detection system, a
variety of predetermined beam signature modes may be
programmed into the logic unit.

A first mode may be referred to as an active mode.
In the active mode, all beams preferably are operating. In
one form if any two of the four beams transmitted from the
lower units and the middle unit are broken simultaneously,
this beam signature may be recognised as an alarm
condition. Any breaks in the beams exceeding approximately
40 milliseconds may be registered for evaluation. The
system may be programmed so as to disregard breaks under a
duration of approximately 40 milliseconds. However, this
time duration may be variable depending upon the
application of the system.

In another form, if any two of the lower four beams
are broken simultaneously for a period of 40 milliseconds,
the system may assume alert mode and after 3 seconds may
enable the alarm. However if the upper beam is broken
during this 3 seconds or at any time, the system may assume
a reset condition for 10 seconds and then revert to active
mode. In the reset condition, breaks in the lower beams

A fourth mode may be known as a party mode. In the party mode lower beam breaks may be ignored for a period of 3 minutes. After this time the system may revert to active mode. If however the upper beam is broken during this time the system may reset to party mode and restart a three minute timer. Party mode may be initiated from the control unit. The control unit may be adapted to select one or more of the operating modes previously described. In one form the control unit may be adapted to program the

10   processing means to recognise preferred beam signatures.

To minimise risk of false alarms, the width of the beams may be relatively large. The width of the beams preferably are no greater than the width of a child's leg. It is also preferable that the beam width is greater than common objects which may pass through the beam such as the ankle of a cat or a dog. The preferable means for registering a break of the beam is such that the break may only be recognised if the entire width of the beam is blocked or broken. This is preferred as it may enable the

20   beam to distinguish the width of a child's leg which may block a beam entirely, from smaller objects which may pass through the beam without blocking the beam entirely.

Optionally the upper, middle and lower beams may have different widths. For example, the beam from the upper unit may be slightly wider than the beams from the lower units. This may assist distinguishing the upper portion of a human torso which is wider generally than that of a child's leg. It may also assist in distinguishing relatively narrow objects which may pass through the upper

30   beam carried by a child, such as a stick or a broom handle.

It is to be understood that these are only preferred beam signatures which may be recognised, and that other beam signatures may be programmed into the system.

The number of posts is not limited within the scope of the present invention. In another preferred system, four posts may be arranged such that beams of

37   electromagnetic radiation surround the designated area.

unit adapted to receive at least one beam from the first slave post.

The first slave post preferably includes associated logic means. In one form each receiving unit in the first slave post may be in communication with the logic means. The logic means may be adapted to receive break data from the, or each receiving unit of the first slave post. The logic means preferably is adapted to recognise predetermined beam signatures. Output from the logic means may be transmitted to the second post via a modulated beam(s). The latter may be modulated in accordance with the output from the logic means.

The second slave post may also include associated logic means. The latter logic means may be adapted to receive break data from the, or each receiving unit of the second slave post. The logic means of the second slave post may be adapted to recognise break data received from the, or each receiving unit of the second slave post. The output from the logic means of the second slave post may be subsequently transmitted to the primary post via a modulated beam(s). The latter may be modulated in accordance with the output from the logic means of the second slave post.

The primary post may be adapted to recognise predetermined alarm conditions as described for a two post system.

A further preferred embodiment of the invention, may comprise reflective means in each of the posts other than the primary post. The primary post in this situation, may act as both a receiving and transmitting means. The reflective means may comprise mirrors and may be aligned in such a manner that the beam will be reflected around the perimeter of the designated area, returning to the primary post. A break or block to the beam pattern may be detected by the receiving units of the primary post.

Any number of posts may be used to house the reflective means. Means other than posts may be incorporated as means to house the reflective means. The

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In figure 1 of the drawings a five beam multiplex system is shown. Each transmitting unit designated Tx1 to Tx5 is incorporated in a secondary post. Each transmitting unit is connected to a multiplex unit MUX as shown. Each transmitting unit has a corresponding receiving unit designated Rx1 to Rx5 incorporated in a primary post. Each receiving unit is connected to a corresponding de-multiplex unit DE-MUX. The de-multiplex unit feeds data from the receiving units to a central processing unit (CPU). The CPU is a preferred processing means. A control unit is incorporated to program the central processing unit, to a selected mode. The CPU is adapted to recognise alarm conditions depending upon the selected mode. An alarm means is triggered by the CPU upon recognition of an alarm condition.

In figure 2 of the drawings, Tx1 to Tx5 designate the transmitting units of a secondary post. Individual modulating units M1 to M5 are associated with corresponding transmitting units Tx1 to Tx5. Corresponding receiving units Rx1 to Rx5 are arranged on a primary post. De-modulating units DM1 to DM5 are associated with corresponding receiving units Rx1 to Rx5. De-modulating units DM1 to DM5 feed data from the receiving units to a central processing unit (CPU). The CPU can be programmed by a control unit to recognise predetermined alarm conditions. An alarm means is triggered by the CPU upon recognition of an alarm condition.

In figure 3 of the drawings, a five beam four post system is shown. This system is a modulated system with transmitting units Tx1 to Tx20 having associated modulating units M1 to M20. Each receiving unit Rx1 to Rx20 has an associated de-modulating unit DM1 to DM20. In this system the secondary post transmits directly to the primary post through transmitting units Tx2, 4, 6, 8 and 10 and to the first slave post through transmitting units Tx1, 3, 5, 7 and 9. Receiving units in both slave posts are connected to respective logic units A and B. In the first slave post, break data received by receiving units Rx1, 3, 5, 7

Microprocessor 57 comprises an 8-Bit EPROM type 68705 with on-board clock, RAM, I/O, and timer. Microprocessor 57 controls all functions of the receiving post 51 and is powered by a 7805, 5 volt regulator as shown at 56b.

Power for the receiving units Rx1 to Rx5 is obtained from the voltage doubler and 16 volt regulator 56a, which is required to allow operation from a 12 volt battery backup.

10   The five receiving units Rx1 to Rx5 are each divided into two halves, an infrared pre amp 80 and a remote control receiver 81. Remote control receivers of receiving units Rx1 to Rx4 use RS927's, which receive only codes beginning with a "1". The remote control receiver of receiving unit Rx5 uses an RS926 which only receives codes beginning with an "0", ensuring 100% security of the upper beam.

The RS486 of pre amp 80 receives PPM signals via infrared photo-diode IR. The associated circuitry allows

20   the pre amp 80 to present, stable PPM signals to receiver 81 for decoding. The decoded D.C. output is then fed into microprocessor 57.

The system shown in figures 5 to 8 has a number of features which enables continued operation or alarm indication in case of a malfunction. These include:

(a)   Alarm mode is assumed if upper beam 5 is not received for a period of 2 minutes;

(b)   If any one of the lower beams 1-4 malfunctions the system remains active, however in this situation only one

30   more of the lower beams is required to be broken to initiate an alarm condition. Similarly if two or more of the lower beams fail, alarm mode is assumed.

(c)   Any beam break must be greater than 40 milliseconds duration before it is registered as a break. This minimises the chances of false alarms from system gliches or falling leaves or birds etc. passing through the beams.

(d)   The alarm times out after a period of time to comply

38   with legislation in some countries.

It will be appreciated that various alterations,
modifications and/or additions may be introduced into the
constructions and arrangements of parts previously
described without departing from the spirit or ambit of the
5   present invention.

The claims defining the invention are as follows:

1.   A detection system for detecting an intruder
passing into a designated area, said system comprising:
        transmitting means for transmitting a plurality of
electromagnetic beams, said beams being arranged such that
said intruder passing into said area may cause a break in
at least one of said beams,
        receiving means for receiving said beams and for
detecting the or each break in said beams,
10   processing means for processing data associated with
the or each break in said beams and for initiating an alarm
condition whenever said data corresponds to a predetermined
number or sequence of breaks in said beams.

2.   A detection system according to claim 1 wherein said
transmitting means comprises a plurality of transmitting
units.

3.   A detection system according to claim 2 wherein each
transmitting unit comprises an infrared diode transmitter.

4.   A detection system according to claim 1, 2 or 3
20   wherein said. receiving means comprises a plurality of
receiving units.

5.   A detection system according to claim 4 wherein each
receiving unit comprises an infrared photo-diode.

6.   A detection system according to any one of the
preceding claims wherein said transmitting means includes
means for multiplexing said beams.

7.   A detection system according to claim 6 wherein said
receiving means includes means for de-multiplexing said
beams.

30   8.   A detection system according to any one of the
preceding claims wherein said processing means comprises an
EPROM microprocessor.

9.   A detection system according to any one of the
preceding claims wherein said processing means is adapted
to evaluate said data associated with the or each break
according to a selected operating mode for said system.

10.   A detection system according to claim 9 wherein said
processing means includes a control unit for selecting said
39   operating mode.

11.   A detection system according to claim 10 wherein
said control unit is adapted to select active mode, sleep
mode, override mode or party mode.

12.   A detection system according to any one of the
preceding claims including alarm means, said alarm means
being actuated by said processing means upon initiation of
said alarm condition.

13.   A detection system according to any one of the
preceding claims wherein said transmitting means is
10   associated with a transmitting post and said receiving
means is associated with a receiving post.

14.   A detection system according to claim 13 further
including at least one slave post.

15.   A detection system according to claim 14 wherein
said at least one slave post is adapted to relay data to
said receiving post.

16.   A detection system according to claim 1
substantially as herein described with reference to figure
1 or 2 or 3 or 4 or figures 5-8 of the accompanying
20   drawings.

17.   A pool alarm incorporating a detection system
according to any one of the preceding claims.

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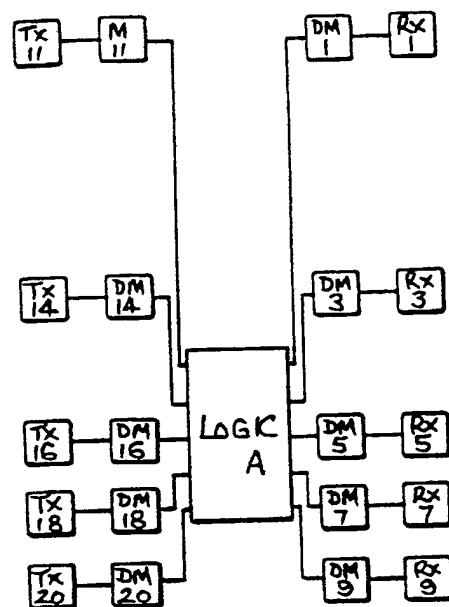SECONDARY POST   FIG 1   PRIMARY POST
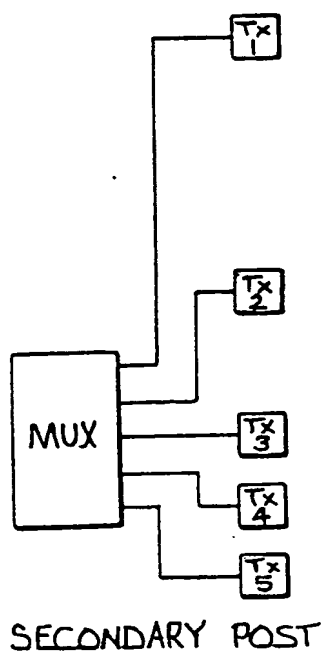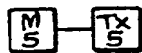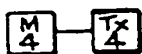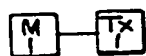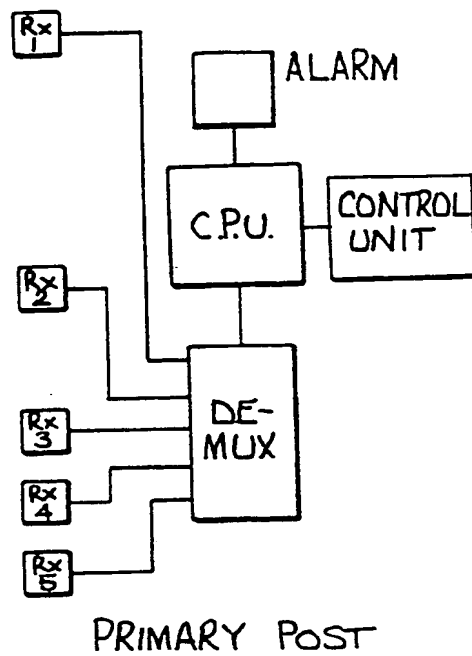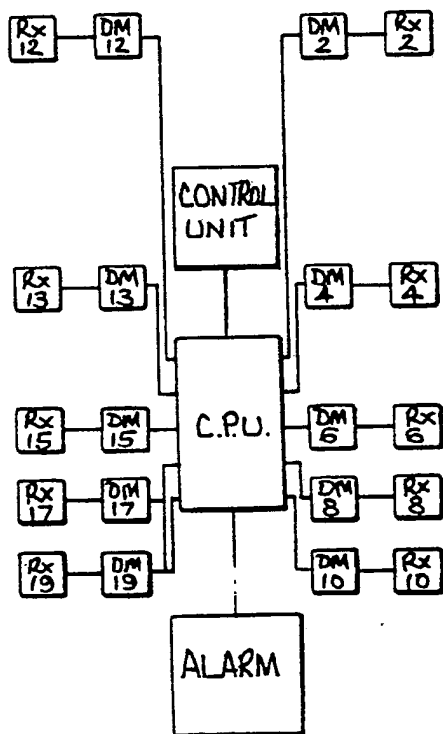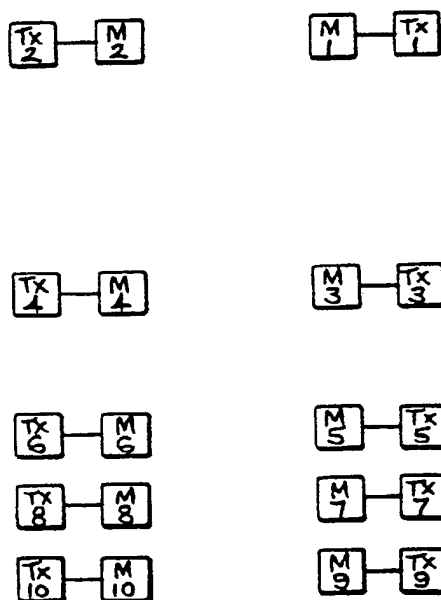
SECONDARY POST   FIG 2   PRIMARY POST
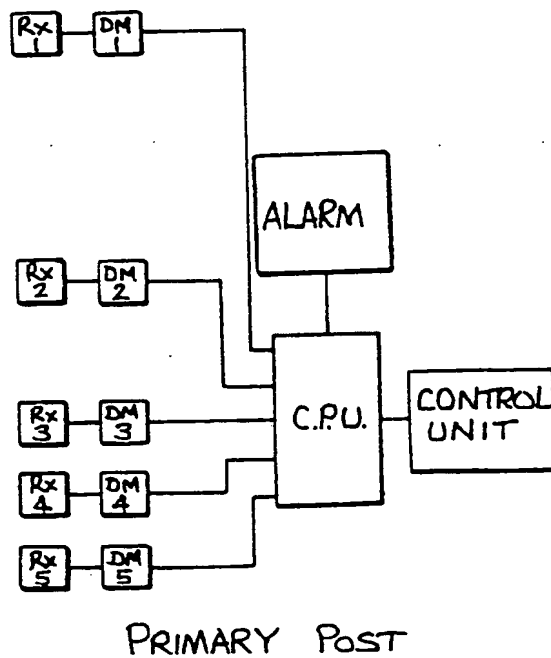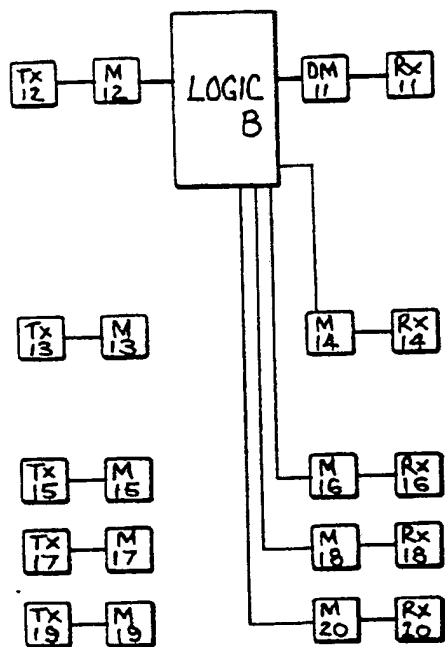
SECOND SLAVE POST
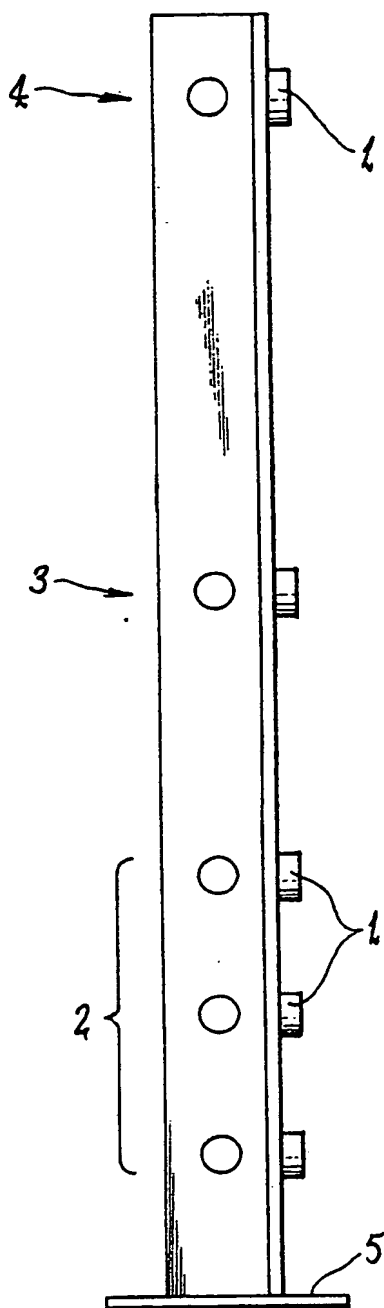
FIRST SLAVE POST

PRIMARY POST

SECONDARY POST

FIG 3

FIG 4
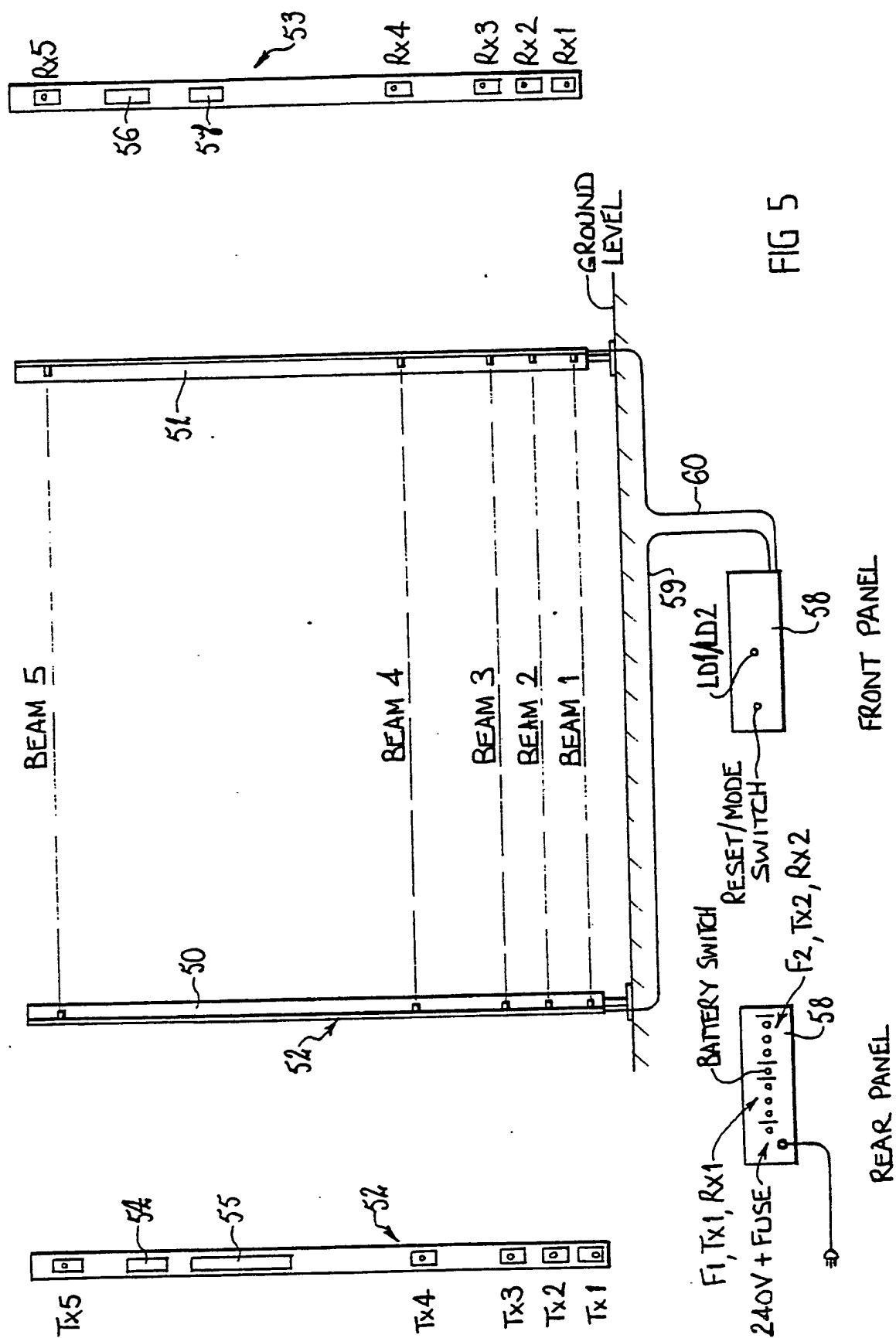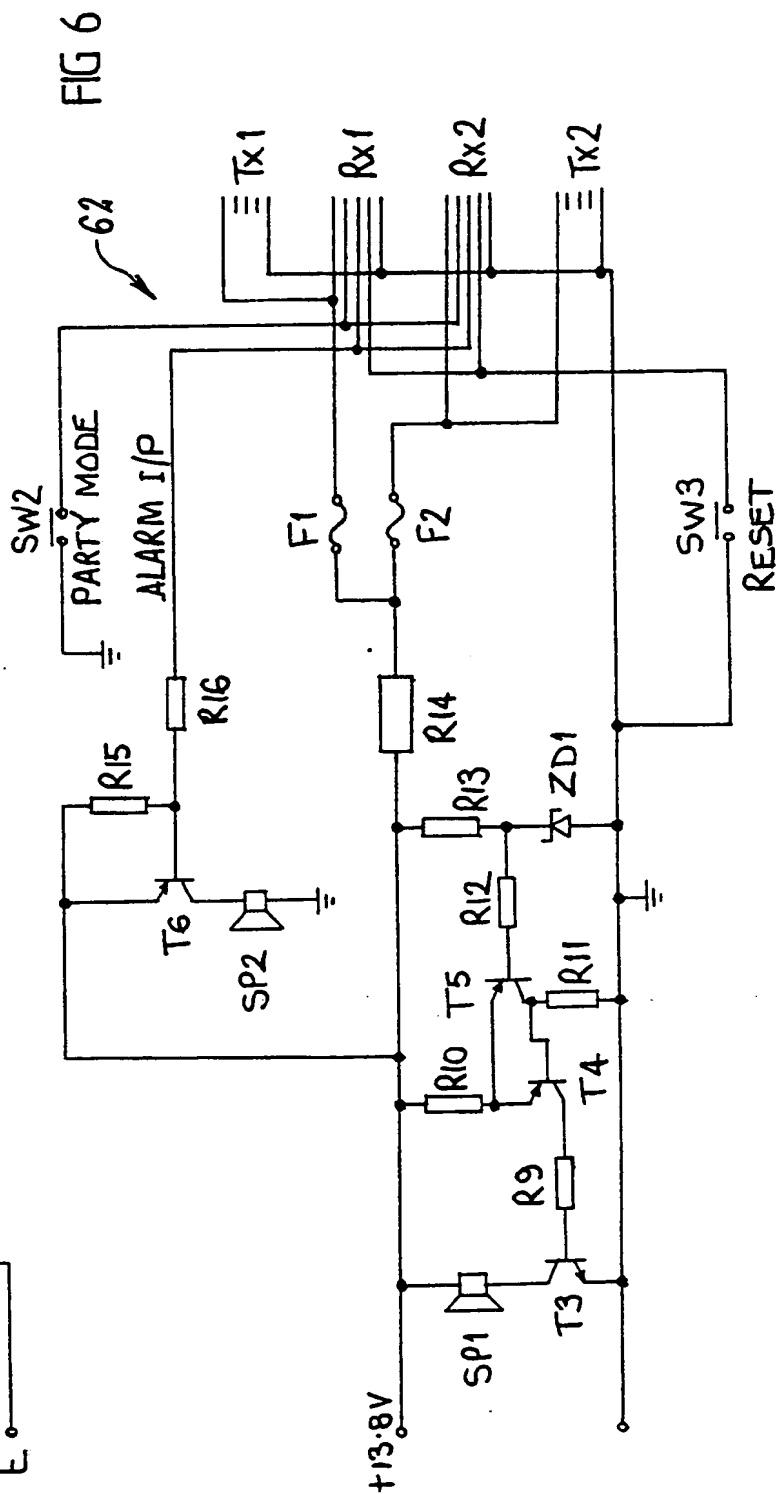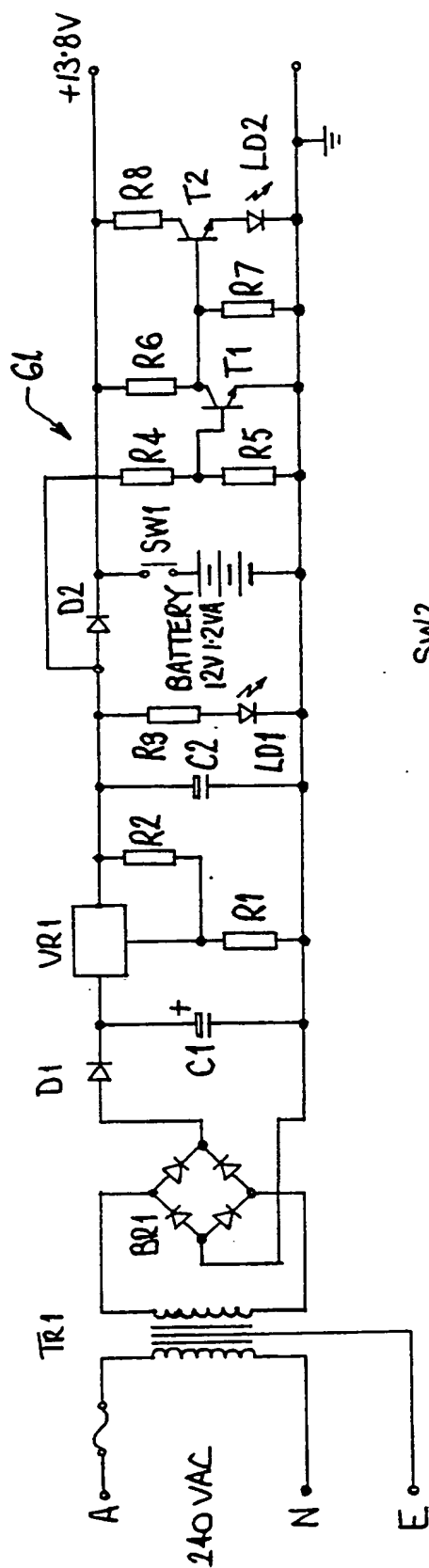
Rx5

53

Rx4

Rx3
Rx2
Rx1

56

57

BEAM 5

51

BEAM 4

BEAM 3

BEAM 2

BEAM 1

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52

GROUND
LEVEL

60

59

LD1/LD2

58

RESET/MODE
SWITCH

BATTERY SWITCH

F2, Tx2, Rx2

58

F1, Tx1, Rx1

240V + FUSE

REAR PANEL

FRONT PANEL

FIG 5

Tx5

54

55

Tx4

52

Tx3
Tx2
Tx1

FIG 6

FIG 7

FIG 8

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)

According to International Patent Classification (IPC) or to both National Classification and IPC

Int. Cl.^{4} G08B 13/18

II. FIELDS SEARCHED

Minimum Documentation Searched

Classification System	Classification Symbols
IPC	G08B 13/18

Documentation Searched other than Minimum Documentation
to the Extent that such Documents are Included in the Fields Searched

AU: IPC as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
X,Y	US,A, 3825916 (SEELE et al) 23 July 1974 (23.07.74)	(1-5,8,12-15, 17)
X,Y	AU,A, 90310/82 (HUGHES TECHNOLOGY PTY LTD) 19 May 1983 (19.05.83)	(1,4,8,12-15, 17)
X,Y	WO,A, 84/04986 (HUGHES TECHNOLOGY PTY LTD) 20 December 1984 (20.12.84)	(1,4,8,12,17)
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Y	GB,A, 1524564 (TELUB AB) 13 September 1978 (13.09.78)	(1-5,8,12,13, 17)
Y	CA,A, 1036686 (XENEX CORP) 15 August 1978 (15.08.78)	(1-8,12,13,17)
Y	US,A, 3688298 (MILLER et al) 29 August 1972 (29.08.72)	(1,8,13-15,17)
Y	US,A, 3898639 (MUNCHERYAN) 5 August 1975 (05.08.75)	(1,2,4,8,13-15, 17)

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
28 September 1987 (28.09.87)	(09.10.87) 9 OCTOBER 1987
International Searching Authority Australian Patent Office	Signature of Authorized Officer R. Hallett R. HALLETT

Form PCT/ISA/210 (second sheet) (January 1985)

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END OF ANNEX